

Computers and Monitors: When Should I Turn Them Off?

Background

Personal computers, including monitors, are one of the fastest-growing users of electricity in the United States. There is much advice about whether or not to turn your computer (and monitor) off when you're away from your desk. While turning computers and monitors off saves electricity and energy bills, some argue that excessive switching shortens their life, thus costing more in repairs and replacement than it saves in electricity. This fact sheet summarizes existing research and recommends under what circumstances personal computers (and monitors) are best turned off.

The electricity consumed by a desktop or mini-tower computer (CPU) and monitor is significant: about 150 watts for a CPU and a 17-inch color monitor (180 watts total for a CPU and 21-inch color monitor). Calculations based on the number of computers used by businesses and homes nationwide indicate significant environmental impacts caused by computer energy use. Battery-powered laptops consume significantly less power.

Key findings

The Oregon State University Extension Energy Program and Oregon Department of Environmental Quality (DEQ) reviewed literature regarding turning computers and monitors off. Key findings from this research support the following recommendations:

- The use of EPA's *Energy Star*¹ features that automatically "power down" monitors and computers after 10 to 30 minutes of inactivity should be encouraged.
- Turn your monitor off (if it has a switch) if not in use for 15 to 30 minutes or more, even if it is an *Energy Star* monitor. The *Energy Star* feature saves energy, but not more than turning off your system.
- Turn your computer off at the end of the day, unless it is a server or other critical application.

Why the controversy?

In the early days of personal computers, it was widely believed that personal computer

components, such as hard drives, were more likely to fail the more frequently they were turned on and off. Replacing this equipment not only cost money, but productivity suffered from lost staff time and unrecovered data. Some company computer managers established policies that employees should leave computers powered up all day and night. Similar arguments were made that even replacing the on-off switch of a monitor would cost more than the electricity saved. To our knowledge, no studies actually documenting these beliefs were published.

Third party information: monitors

- "Assuming an average switching cycle number of five per working day, we expect (that) after more than 20 years, there would be a deterioration in the availability because some output transistors, components of the control and deflection electronics — impaired by the thermal cycles — would have to be exchanged . . . In light of the above conclusions, it seems to make sense and it seems to be appropriate to turn the PC monitor off every time it is not used for more than about 15 to 20 minutes." (*Dr. L. Miteff, ETH Confederation, Technical College, Zurich, Reliability Engineering Department*).
- "If you want to save electricity, switch the monitor - a big power eater - *off* when the computer will be idle for more than an hour. Also, if your monitor is Energy Star-compliant, set it to go into Sleep or Standby mode after several inactive minutes." (*PC Upgrade, 1998*).
- "Another common myth . . . is that screen savers save energy. Screen savers do not save energy. In fact, a typical screen saver works as an executable program, causing power to be drawn to the monitor to display the screen saver and to the CPU in order to run the program. The only way to ensure that a monitor saves energy while it is turned on is by activating the power management features, thus enabling the monitor to reduce power consumption when it is not in use." (*Andrew Fanara, U.S. EPA Energy Star Office Equipment Program Manager, personal communication*).



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¹ To find out more about the Environmental Protection Agency's *Energy Star* program call: 1-888-STAR-YES or visit: <http://www.energystar.gov/default.shtml>

Third party information: personal computers

- “The technological reasons for avoiding cycling of PCs probably no longer apply . . . There has been much controversy over whether to shut PCs off when they will be off for only a short time. This controversy has revolved around the effect of cycling on equipment lifetime and reliability. The conventional wisdom says that cycling PCs can damage the hard disk. This conventional wisdom dates back to earlier days when disk storage devices did not automatically park themselves when shut off. . . . Shepard et al. found that modern hard disks are not significantly affected by such cycling . . .

Modern personal computers are extremely reliable devices. Under normal usage, economic obsolescence (which typically occurs in about five years) is more dangerous to a PC than user-induced wear and tear. We adopt the assumption that cycling the computer several times a day will not have a significant effect in the operating lifetime of the device or on the maintenance cost associated with the device. . . . A strong case can be made for turning off the PC at night . . . the benefit of extending the useful life of the PC can be an important one . . . many computers perform diagnostic tests on start-up, and never cycling the PC means that these diagnostic tests are not performed on a regular basis.”

(“The economics of cycling personal computers,” Jonathan G. Koomey [Lawrence Berkeley Laboratory], Timothy Oey [Apple Computer] and Eric Bergman [Sun Microsystems Inc.], published in Energy Policy, September 1993).

- “One of the reasons why people used to leave their machines on day and night has been largely eliminated. Back in the mid-1980s, computers were loaded with memory chips that had little metal legs. When heating up and cooling down, the legs could expand and contract, making them pop out of their sockets. Computers being sold these days generally do not use chips with metal legs. What helps wear out a computer in the long run is the shock of electricity blasting through those delicate microscopic circuits when you turn the machine on. But in leaving the machine on around the clock, you run up your electric bill, you suck in dust, and you make yourself more vulnerable to power surges. So here’s Gilroy’s law: Turn it on in the morning and turn it off when you go home at night.”

(John Gilroy, “Ask the Computer Guy,” The Washington Post, July 11, 1994).

The table below illustrates the typical number of cycles needed to occur before the system breaks. According to the table, the disk drive of a regular computer is the equipment with the least tolerance for frequent on-off cycling, with an average of 20,000 cycles in its lifetime. Thus, an average computer could be turned on and off four times a day, five days a week for 20 years before the disk drive is likely to fail.

- “Leaving a computer on has little effect on its life or reliability. The computer just uses more energy than when it’s off . . . Shutting off the computer between uses — whenever it’s practical to do so — makes the most sense if you’re concerned about saving energy.” *(Consumer Reports, September 1998).*

Table: System Component Power Cycles

Component	Allowable number of power cycles in lifetime
Monitor (regular)	At least 25,000
Monitor (Energy Star)	At least 80,000
CPU chip	Varies with technology and packaging
Printed circuit board	At least 90,000
Disk drive (laptop)	At least 40,000
Disk drive (regular)	At least 20,000
Disk drive (high capacity/speed)	At least 3,000
Fan, power supply, etc.	At least 75,000

Source: "Thermal Stress Relief with Power Management," Robert Gianni, Peter van der Linden, Oscar Arreola, Hui-Mei Chen, Sudershand Goyal, James Marks, Saeed Nowshadi, and Terry Whatley, Sun Microsystems, Inc., published in January 1997 proceedings of IEEE.

Conclusion

As the personal computer industry has matured, the reliability of components has improved. If you’re still really concerned about causing problems by turning your computer off when not in use, we recommend consulting the equipment manual to see if there are any warnings about turning computers off (or leaving them on).

Historic reasons for not turning monitors and PCs off (mechanical failure, heat stress, etc.) appear to have been largely addressed by the PC industry. In fact, some literature suggests that turning monitors and PCs off when not in use will *extend* (rather than shorten) their useful life. Additionally, turning equipment off when not in use will reduce the cost of operating a computer substantially, as well as reduce the significant environmental and climate impacts caused by electricity generation.